

1.1 Day in the Life: Butter-making

Topics/Subject: history, science

Lesson Overview

Students will learn about the lifeways of coal miners' and their families. This lesson focuses on nutrition and subsistence practices of the 19th century through a historic case study. This lesson also incorporates the sciences (i.e. physical science and chemistry).

Objectives

- Students will be able to list 2 food items made by hand in the 19th century.
- Students will learn the science behind the creation of butter.
- Students will learn how to make butter – the 19th century way.

Activities/Assessments

Butter making (see activity directions and prompt)

Standards

- 8.1. Historical Analysis and Skills Development
 - D. Historical Research
- 8.2. Pennsylvania History
 - A. Contributions of Individuals and Groups
 - B. Documents, Artifacts, and Historical Places
 - C. Influences of Continuity and Change
- 8.3 United States History
 - A. Contributions of Individuals and Groups
 - B. Documents, Artifacts, and Historical Places
 - C. Influences of Continuity and Change

STEELS

- 3.1.3.B Social Interactions and Group Behavior
- 3.2.2.D Physical Science (changes caused by heating)
- 3.2.10.A4 Describe Chemical Reactions, Organic chemistry - bonding & structure

Vocabulary (Science)

States of Matter: phases in which a substance can occur

- **Solid:** Tightly packed particles that vibrate in a fixed structure, giving them a definite shape and volume.
 - Characteristics: holds shape, fixed volume
- **Liquid:** Loosely bound particles that slide past one another, maintaining a fixed volume but adapting to the shape of a container.
 - Characteristics: takes shape of container or free surface, and has fixed volume
- **Gas:** Freely moving, spread-out particles with very weak bonds, allowing them to fill any container and change both volume and shape.
 - Characteristics: takes shape and volume of container

(<https://www.grc.nasa.gov/www/k-12/BGP/state.html>)

Particles: tiny building block of matter

Emulsion: a mixture of two or more liquids that usually don't mix. E.g. oil and water

Phase inversion: a controlled process that alters the structure of a substance; in this case a liquid to a solid

Membrane: a thin, flexible, selectively permeable layer that acts as a boundary, barrier, or filter

Activity Instructions

Materials:

- 2 oz. condiment cups with lids (one for each person)
- wet wipes
- heavy whipping cream (1 quart per 16 persons)

Directions

- Fill each condiment cup a quarter of the way. (Use less for younger kids and more for older, but do not fill past half.) Replaced lid.
- Demonstrate how to hold cups – thumbs on bottom, pointers on top; hold firm, but don't squeeze.
- Instruct to shake the cups as you read the history-based and/or the science-based prompts

Background Information (History focus)

***If teaching/interested in physical science or chemistry, see next page. This is great for incorporating physics and chemistry, to connect science and history, and serves as a unique experiment.

The people who lived in Eckley in the 1800's were very self-sufficient. This means that they didn't need to rely on others to survive. They made many of the products that you and I would buy from the grocery store today, such as bread. One of the products made by hand would be butter. Many villagers owned livestock like cattle, and they would get their milk from these cows. Usually, it was children like you who would be sent by their mother to milk the cow or take care of other animals.

After collecting the milk, they would let it sit out for half a day in shallow earthenware dishes, allowing tiny fat molecules to float to the top and forming a layer of cream that can be skimmed and collected. Sometimes cream was collected from a few days' worth of milk to have enough to make a decent amount of butter. After enough had been collected, the cream was put into a wooden instrument called a churn. The churn often was a wooden barrel with a hole in the lid (*show photo*). A wooden pole with a plunger-like attachment was inserted through the hole.

Women would pull the plunger up and down to agitate the cream. This agitation, or stirring, caused fat molecules to get shaken out of position and clump together. Eventually, after enough agitation, the fat molecules clump so much that butter would form. *Room temperature cream forms butter more quickly than cold cream because the molecules can move faster.* The liquid left over after the butter has formed a lump is called buttermilk.

At this point in the process, the butter is still not quite ready yet. There would still be pockets of buttermilk within the butter that needed to be removed in order to improve the flavor, as well as help keep the butter from spoiling. They did not have electricity which meant no refrigerators. The butter was often kneaded by hand or with a wooden spoon to remove the excess buttermilk. Then, sometimes salt was added, once again for both flavor and preservation. At this point in time, salting foods was a common method of preservation.

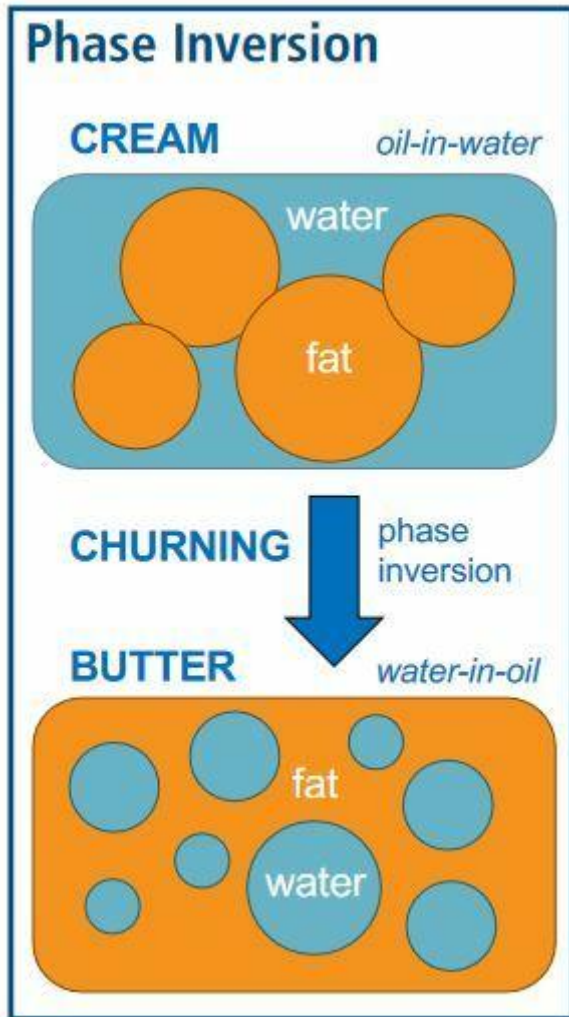
In more prosperous households, the butter might then be pressed into a mold. Butter molds would not have been used at Eckley because it would be seen as a frivolous use of what little money they had. Instead, butter would have been scooped into crocks or shaped by hand into basic blocks.

After the butter was made, it was either left out, or it would have been moved to the root cellar. The root cellar was a dirt-floor basement built under the house. Because it was underground, it stayed cool all year round. This was not as efficient as our modern-day refrigerating system, but it did help preserve some foods.

Butter was a very essential part of cooking at Eckley. Many of the traditional recipes used large amounts of butter. Staples like pierogis were often slathered in butter. Potato pancakes called for butter, while normal pancakes used the buttermilk. Women spent a large portion of their time baking bread. This hand-made bread was an important staple as well. Often, toast or buttered bread was a large part of their meal.

The Science of Butter

Figure 1 - <https://cdr.wisc.edu/butter-science-101>



When you agitate (or shake) the cream, you are smashing the molecules together and that resulting friction causes them to heat up. The heat ruptures the protective **membranes** around the fat droplets. The fats then clump together, eventually separating the solid fat (butter) from the remaining liquid (buttermilk).

Understanding the step-by-step physical and chemical changes:

- **Initial Whipping:** Agitation introduces air, creating a foam where fats cluster around air bubbles. This is the whipped cream stage.
- **Membrane Rupture:** Continued shaking (and the resulting heat) forces the membranes around the fat droplets to rupture.
- **Phase Inversion:** Because fat repels water, the freed fat molecules eagerly stick to each other rather than remaining in the water. They clump together into a large, solid mass (butter), forcing the water out as liquid buttermilk.